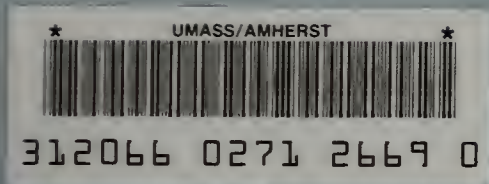


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Division of Air Quality Control

INDOOR AIR POLLUTION CONTROL IN MASSACHUSETTS

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INDOOR AIR POLLUTION CONTROL IN MASSACHUSETTS

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DAQC Information Systems

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ABSTRACT

The Massachusetts Department of Environmental Quality Engineering, Division of Air Quality Control (DEQE-DAQC) is currently exploring the feasibility of developing a program plan for regulating and monitoring indoor air quality in Massachusetts. Since no other federal or state agency is actively engaged in addressing the problem, DEQE is proposing the available options for a state program for improving both indoor and outdoor air quality. Indoor air pollution is known to present a significantly greater threat to public health than outdoor air because of the higher pollution levels and the greater proportion of time spent indoors. Five options are available to DEQE for regulating indoor air pollution. The first option is to have no DEQE action in which the problem is left up to the free market system and the current level of partial state programs. The second option is an independent DEQE program which should supplement the other partial state agencies' programs. The third option is the formulation of a comprehensive state program comprising DEQE and other state agencies performing their respective functions in addressing the major aspects of the problem. Since indoor air pollution presents such a great risk to public health, it is imperative that some state action or program be formulated in order to address this problem. The fourth option involves the incorporation of indoor air pollution control into the current state Right-to-Know program. The fifth option is a joint program between DEQE and the Department of Labor Industries which would combine indoor air pollution control in both workplaces and residences. DEQE is well poised to fill a gaping public health need which has not been adequately addressed by the partial programs of the other state agencies in controlling indoor air pollution.

1. INTRODUCTION

"Indoor air" is taken to mean the environments within residences, schools, public buildings and similar places to which the public has access; it does not include industrial working environments.¹ It has been traditionally assumed that air pollution is primarily an outdoor phenomenon in which buildings provide a sanctuary from harmful air pollution. However, recent studies are increasingly revealing that the potential danger from air pollution is no longer confined to outdoor air, but that a greater health risk may be present right inside our homes. While reduction efforts to control outdoor air pollution have been partially successful, the consistently high level of air pollution indoors requires immediate attention.² The increasing national emphasis on energy conservation over the last decade is manifested in more airtight, super-insulated homes, and a switch to low cost fuels such as wood, coal and gas have contributed to the elevated levels of air pollutants indoors. In addition, tobacco smoking, woodburning, building materials and other synthetic sprays are significant sources. Recent studies have revealed that indoor air pollution levels from these sources may surpass outdoor levels, hence posing a greater risk to public health. Elevated levels of air pollution indoors may further pose a significantly greater health risk than outdoors because residents spend over 90 percent of their time indoors.³

Indoor air pollutants are known to pose a significantly greater health risk to the high risk group comprising infants, pregnant women, elderly and asthmatics. However, the potential health risks to the general population, particularly in the long term, are still to be documented and established. The indoor environment may be ideal for the proliferation and synergistic effects of air pollutants because of the low ventilation, and higher temperature and humidity.

The purpose of this research paper is to address the issue that indoor air pollution presents a greater public health risk than ambient air pollution, and there is very little explicit regulatory authority to address indoor air pollution although there is a preponderance of laws and regulations to address ambient air pollution. The Clean Air Act is the major federal statute which gives EPA regulatory authority to regulate outdoor, ambient air only.⁴ No other federal or state agency has any direct legal authority to regulate indoor air quality. The newly formed Federal Interagency Committee on Indoor Air Quality is a major federal step in addressing the research and evaluation of the problem. The lack of a direct federal policy to address indoor air pollution has stimulated states and localities to adopt programs of their own. This has sometimes resulted in fragmented, conflicting and inconsistent policies and programs among the states.⁵

The lack of a regulatory policy on indoor air quality suggests that the conventional wisdom of air quality needs revamping. This would require modifications of the existing institutional and regulatory policies to encompass indoor air in order to address the

total exposure concept of air pollution. At this early stage of policy formulation, a wide range of policy options exists for addressing the problem. It is imperative that control strategies be formulated and implemented as early as possible, since indoor air pollution is known to present the greatest threat to public health.

The Massachusetts Department of Environmental Quality Engineering (Division of Air Quality Control) (DEQE-DAQC) is the state agency and division mandated by State for the regulation of air pollution under the Clean Air Act. This entails the regulation of ambient air in that DEQE has no statutory authority to regulate indoor air. Because the increasing awareness of the health risks of air pollution indoors is manifested in the increasing number of calls from Massachusetts residents, DEQE is giving consideration to developing a state program for addressing the problem of indoor air pollution. The major focus of this research paper is to address the available options and the role that DEQE together with other state agencies should play in improving indoor air quality in Massachusetts.

The major sources of indoor air pollutants and their health effects are discussed in Section 2. The problems, conflicts and constraints of the federal and state agencies' are addressed in Section 3. Section 4 presents some options available at the state level for improving indoor air quality.

2. SOURCES OF INDOOR AIR POLLUTANTS AND HEALTH EFFECTS

A comprehensive knowledge of the sources of indoor air pollution is of primary importance for understanding the magnitude of the potential health risks and for developing strategies and policies for control. Recent toxicological studies demonstrate that indoor air pollution is significantly higher than outdoors, thus posing a greater health risk. Monitoring studies have been concerned exclusively with outdoor or ambient air pollutants. The majority of the air pollutants have national standards and their measurement techniques have been well developed. Research on indoor air pollutants and their health effects is still to be developed and the magnitude of the concentrations has not been adequately characterized.

There are two broad categories of indoor air pollutants: those generated outdoors which infiltrate indoors and those generated indoors as a result of human activities and building materials (Table 1). Indoor activities include smoking, gas stove use, cooking, cleaning, woodburning, pesticide use and use of a wide variety of consumer products. Building materials and interior furnishings together with radon contribute significantly to indoor air pollution. Radon is a radioactive gas which occurs naturally in some bedrock and which can be emitted from building materials.

TABLE 1

2-1 SOURCE CATEGORIES OF INDOOR AIR POLLUTANTS

COMBUSTION BY-PRODUCTS

Gas and Kerosene Appliances

CO, NO_x, TSP, SO₂, CO₂.
 Hydrocarbons,
 Sulfates
 Nitrates

Wood-Burning

CO, NO_x, TSP, SO₂
 Hydrocarbons
 Polycyclic Organic Compounds
 Benzo-a-pyrene
 Nitrates

Tobacco Smoking

CO, TSP
 Benzo-a-pyrene
 Nicotine
 Nitrosamines
 Acreleins
 Polycyclic Organic Compounds
 Arsenic
 Aldehydes

BUILDING MATERIALS

Formaldehyde
 Radon
 Asbestos
 Alkanes
 Aromatic Compounds
 Hydrocarbons
 Terpenes
 Toluene
 Benzene

OTHER INDOOR SOURCES

Aerosols:

Ammonium Sulphates
 Volatile Organic Compounds
 Toluene
 Vinyl Chloride

Pesticides and Detergents:

Ammonium Sulphates
 Sodium Hydroxide
 Toluene
 Vinyl Chloride

Microbes:

Spores, fungi, molds
 Allergens, bacteria
 House Dust Mites

OUTDOOR AIR POLLUTANTS

Sulphur Dioxide
 Carbon Monoxide
 Nitrogen Dioxide
 Total Suspended Particulates
 Ozone
 Lead
 Volatile Organic Compounds
 Pollen

Source: Wesolowski, Jerome J. "An Overview of Indoor Air Quality",
 Journal of Environmental Health. May/June 1984.

2.2 COMBUSTION BY-PRODUCTS

A wide range of toxic by-products are emitted from indoor combustion of gas and kerosene appliances, woodburning stoves and furnaces, and tobacco smoking. Among the extensive range of harmful air pollutants emitted indoors, the most widespread are: carbon monoxide (CO), carbon dioxide (CO₂), nitrogen dioxide (NO₂), sulfur dioxide (SO₂), total suspended particulates (TSP) and a wide range of volatile organic and inorganic compounds (Table 1).

Gas appliances: are used in over 50 percent of residences in the U.S. mainly for cooking and heating.⁶ Evidence from the Harvard Six-City Study clearly indicates that air pollutants such as NO₂, CO, and TSP were more than twice the level in residences with gas stoves than homes with electric stoves.⁷ A Boston study also revealed that indoor levels of TSP, NO₂, nitrates and hydrocarbons were higher in residences with gas stoves than those with electric stoves.⁸ Both studies indicated that indoor air pollution levels were more than twice the outdoor levels. An Arizona study showed that residents, particularly children, with gas appliances had more than twice the level of asthma, wheezing and coughing in the short term than residents with electric appliances.⁹

Woodburning: Wood is the oldest fuel known and its use is being revived in Massachusetts. Woodburning stoves and furnaces emit a wide array of toxic air pollutants including CO, NO₂, TSP, hydrocarbons, the carcinogenic polycyclic organic matter (POM) compounds, and benzo-a-pyrene.¹⁰ One study has suggested that a woodburning stove can emit ten times more CO on a cold day than the average car does on a 50 mile trip.¹¹

Tobacco Smoking: Over 30 percent of the U.S. population smoke cigarettes regularly and more than half of all households have at least one smoker.¹² In addition, "passive smokers" are often involuntarily exposed to tobacco smoke indoors which contains CO, TSP, POMS, benzo-a-pyrenes, nicotine, nitrosamines, and arsenic.¹³ The Six-City study showed that residences with two smokers elevated the TSP levels more than three times the outdoor levels than non smoking residences.¹⁴ Smoking can lead to eye and throat irritations, headaches, coughing, and wheezing. Chronic exposure leads to bronchitis, emphysema and lung cancer. The Surgeon General, in 1982 estimated that 85 percent of all lung cancer deaths are attributable to smoking and passive smoking.¹⁵ A British study demonstrated that non-smoking wives whose husbands smoke, had significantly higher lung cancer rates than other women. A study conducted at Brigham and Women's Hospital in Boston demonstrated that children of smoking parents, particularly mothers, had higher rates of respiratory ailments and almost 10 percent lower lung growth than children of non-smoking parents.¹⁶

2.3 BUILDING MATERIALS

Building materials and interior furnishings are a major source of hazardous air pollutants which include formaldehyde, radon and asbestos. Other toxic air pollutants are alkanes, terpenes, toluene, benzene, and aromatic compounds.¹⁷ Most of these are emitted from old, new, and newly renovated buildings.

Formaldehyde is found in common household items such as plastics, fabrics, adhesives and wax-paper. However the major source is from urea formaldehyde foam insulation (UFFI), particle fiberboard, carpeting and upholstery. The Massachusetts Department of Public Health found that many homes exceeded the recommended standard of 120 ug/m³.¹⁸ Formaldehyde has a pungent odour and low levels can cause eye, upper respiratory irritations, rashes and dizziness. Higher levels may cause nausea, nosebleeds, asthma, diarrhea, pulmonary edema, inflammation and pneumonia. Formaldehyde is known to cause nasopharyngeal carcinoma, and is also teratogenic and mutagenic.¹⁹

Radon is an organic, chemically unstable radioactive gas formed from radium 226 which is commonly found in granitic rocks which is widespread in Massachusetts and New England. The process of decay to form radon daughters or progeny gives off radiation which attaches to particles. Building materials, particularly those made from granite, may emit radon. Levels may be high in basements and crawl spaces in areas where the bedrock is granitic and contains radon. Groundwater in contact with radon bedrock may contain radon which could be radon released through taps in the indoor environment. Radon in combination with fine particles is inhaled deeply, and is easily retained and irradiates the lungs, thus resulting in lung cancer and many other pulmonary ailments.²⁰

Asbestos is the collective designation for a group of inorganic minerals that are found in silicate soils and are fibrous, flexible, incombustible and durable. Asbestos is commonly used in Massachusetts in building materials particularly for insulation. Over 2,000 household products, such as roofing and siding materials, textiles, papers, filters, cement, pipes and acoustic insulation contain

asbestos. It is fibrous, incombustible, and once released it remains airborne for a long period of time. It is easily inhaled and retained deeply into the lungs.²¹ Among the common ailments are asbestosis, lung cancer, gastro-intestinal cancer and mesothelioma. Asbestos is known to react syner-gistically with tobacco smoke as a co-carcinogen.²²

2.4 OTHER INDOOR AIR POLLUTANTS

A wide array of additional pollutants contribute to the high level of air pollution indoors which include aerosols, pesticides, and microbes.

There are over 50 types of aerosol products in the average household in the form of hair-sprays, deodorants, air fresheners, insect repellents, cleaners, detergents and paints. These emit a plethora of toxic air pollutants which may have considerable additive and synergistic health effects. Pesticides used indoors can emit toxic fumes such as toluene, aldrin, and other biocides which may be carcinogenic and cause a wide range of respiratory diseases.²³

Microbes comprise living organisms such as viruses, molds, pollen, bacteria, and other pathogens which are hospitable in the warm, humid indoor environment. Microbes can also be allergens, originating from house dust, animal dander, fecal matter and fungal spores. Among the common ailments are tuberculosis, measles, asthma, smallpox, influenza and rhinitis.²⁴

The chronic effects of air pollutants indoors are still to be established. It is estimated that over 40 percent of the population comprise the "high risk" group which includes the elderly, infants, asthmatics, pregnant women and mouth-inhalers, most of which spend a greater proportion of time indoors.²⁵

3. INSTITUTIONAL AND LEGAL CONSTRAINTS

As scientific interest in the problem of indoor air pollution continues to grow, research efforts to track sources, measure concentrations, define exposure levels and estimate health risks, are still in an embryonic stage of development. At this stage, policy makers at the federal and state levels are faced with a familiar dilemma: a formidable task of protecting public health and safety from indoor air pollution in the face of incomplete and contradictory information. The major uncertainty appears not to be whether indoor air is a problem, but rather which pollutants are significant in terms of public health risk and what can be done within the current state-of-the-art, to limit that risk to acceptable levels.

The current federal and state statutory mechanisms for dealing with the potential health hazards of indoor air pollution are grossly inadequate. Federal and state involvement at the research stage of the process has been haphazard and slow. Programs so far have been redundant, duplicative and contradictory, and have led to conflicts, delays, and inaction.²⁶ The biggest conflict among the federal agencies directly and indirectly involved with indoor air pollution control, is that it does not fall within any of their statutory mandates. No statute has been enacted into law which gives any one federal agency direct responsibility to conduct research and develop strategies for addressing indoor air pollution.²⁷

A federal interagency Committee on Indoor Air Quality (CIAQ) was set up by Congress in 1979 as a primary measure to coordinate related federal agencies in order to address the problem of indoor air pollution control. This committee consists of 15 federal agencies with the lead role designated to EPA. The co-chairs include the Consumer Product Safety Commission (CPSC), Department of Energy (DOE), and the Department of Health and Human Services (DHHS). The other federal agencies include the Housing and Urban Development (HUD), Occupational Safety and Health Administration (OSHA) of the Department of Labor, the National Bureau of Standards (NBS), and the Federal Trade Commission (FTC).²⁸

The federal agencies fall into one of three categories depending on their activities. The research category includes the NBS which establishes product standards. The action category includes the FTC whose function is to promote accurate information on consumer protection. The EPA, DOE and CPSC have both research roles and regulatory functions.²⁹

Although founded in 1979, the CIAQ met for the first time in December 1983. The agenda was focused mainly on the inventory of federal indoor air quality research, identifying gaps and overlaps, and establishing a data base. The responsibilities of the federal agencies will be addressed as to their limitations in controlling indoor air pollution.

3.1 ENVIRONMENTAL PROTECTION AGENCY (EPA)

The EPA was granted the largest sum of \$2 million in 1985 among federal agencies for taking the lead role in controlling indoor air pollution. Four of EPA's statutes may have a limited bearing in addressing the problem of indoor air pollution: the Clean Air Act,³⁰ Toxic Substances Act,³¹ Federal Insecticide Fungicide and Rodenticide Act,³² and Uranium Mill Tailings Radiation Control Act.³³

The Clean Air Act

EPA's statutory authority in regulating air pollution is vested in the Clean Air Act. This act has been interpreted by EPA to encompass outdoor air and to exclude the regulation of indoor air quality. The act defines "air pollutant" as "any pollution agent which is emitted into or otherwise enters the ambient air." The center of controversy concerns the definition of the term "ambient" because the act does not define the term, and it is uncertain whether it includes indoor air.³⁴ EPA's interpretation of the mandate, defines "ambient air" as "that portion of the atmosphere, external to buildings, to which the public has access." Former EPA administrator, Ann Gorsuch, in 1981, made it clear that there is no construct under the current law for regulation of indoor air pollution by EPA, and that EPA does not have the legal authority to study indoor air pollution because "ambient air" is universally construed to mean "outdoor air." No strong movement exists to change the definition of "ambient" to encompass "indoors" as this would be contrary to the legislative history of the act.³⁵ In this act there are two mandates under which indoor air pollution could be controlled, but they may pose many administrative problems.

The National Ambient Air Quality Standards (NAAQS) specify maximum levels for "criteria" pollutants and each state is responsible for the attainment of the standards (Table 3). NAAQS exist mainly for combustion-type pollutants, but there is no coverage for indoor air pollutants such as radon, asbestos and formaldehyde.³⁶ New NAAQS would have to be developed for these indoor air pollutants and this is a lengthy and complex process which may take several years to establish the health effects at various exposure levels. Furthermore, the current NAAQS is based on outdoor exposure which is only about 10 percent of total exposure, compared to 90 percent of the indoor exposure.

The National Emission Standards for Hazardous Air Pollutants (NESHAPS) is the principal regulatory authorization for controlling airborne pollutants not covered by the NAAQS.³⁷ The purpose of this statute is to permit swift, nationwide regulation of ambient toxic pollutants, particularly from stationary sources. The EPA has confined its regulatory activities to cover the designated pollutants such as asbestos, beryllium, mercury and vinyl chloride. In order to avoid expensive law-suits, EPA has avoided under NESHAPS, the regulation of other non-criteria ambient air and indoor pollutants.³⁸

Toxic Substances Control Act (TSCA)

TSCA gives EPA authority to regulate toxic substances and can limit the manufacture and distribution of toxic chemicals or it can require special labelling.³⁹ TSCA requires EPA to justify any action by cost-benefit analysis because of the potential negative impact on manufacturers of products which are toxic. This is a major problem

because quantification of the health effects is extremely difficult because of the uncertainty of the health risks in the long term. The regulatory aspect of TSCA concerning indoor air pollution has not been effective because of EPA's preoccupation with the burdensome inventory and testing of over 55,000 toxic chemicals. This act is too "product" oriented and it would be unsuitable for addressing indoor air pollutants such as radon and combustion gases.

3.2 OTHER FEDERAL AGENCIES

Thirteen other federal agencies comprise the CIAQ. They include: The Consumer Product Safety Commission (CPSC), Department of Energy (DOE), Department of Health and Human Services (DHHS), Department of Housing and Urban Development (HUD), and the Department of Labour-Occupational Safety and Health Administration (OSHA).

The CPSC is authorized under the Consumer Product Safety Act (CPSA) to regulate manufactured products which may have an impact on indoor air quality such as stoves, space heaters, aerosol sprays, and cleaners.⁴⁰ Toxic products can be banned and manufacturers can be required to refund, repair and replace the product or be sued by the CPSC. Authority is limited to consumer products' such that houses and building materials are excluded. Cigarettes are also excluded.⁴¹

The DOE's recent emphasis on energy conservation has resulted in more airtight structures thus contributing to the further entrapment of indoor air pollutants. DOE, together with the American Society of Heating, Refrigeration and Air Condition Engineers (ASHRAE) have developed ventilation standards to improve indoor air quality. The standard is considered to be ineffective because it only applies to new construction.⁴²

The DHHS has delegated the National Institute for Occupational Safety and Health (NIOSH) for research relating to indoor air pollution in the workplace. NIOSH provides research support for OSHA, the regulator of workplace conditions.⁴³ This does not include air quality within residences.

HUD is responsible for the provision of safe residential housing. Through building codes and standards, HUD may affect the level of indoor air pollution. However HUD is limited in that the codes only apply to new housing construction.⁴⁴

3.3 STATE ACTIONS

At a time when EPA's indoor air quality research and control program is still to be established, and the agency seems reluctant to take action, several states and localities are moving ahead on their own initiative to institute mandatory control programs. These include

the Northwestern states of Oregon, Montana, Nevada, and Colorado. Their objective is to reduce the level of both indoor and outdoor air pollution from woodburning appliances.⁴⁵ The EPA is providing technical support and guidance to permit Florida, Pennsylvania and other states to address problems of indoor radon exposure.⁴⁶ California has the most advanced indoor air quality program which is federally funded. California is conducting the most extensive state research program particularly on formaldehyde and has proposed an indoor standard of .05 ppm.⁴⁷ Massachusetts Department of Public Health banned the use of UFFI but this ban was successfully challenged in court in 1983.⁴⁸

Although several cities and towns in Massachusetts have passed legislation to limit smoking in restaurants, there is no official state smoking policy. However, a House Bill is being proposed such that restaurants with 75 or more seats should provide designated non-smoking sections. This bill is grossly inadequate because sidestream smoke may pose a greater health risk in smaller restaurants where the space is more confined. This bill would prohibit smoking in public buildings such as a library, courtroom or museum.⁴⁹

Massachusetts and other states have only partial programs for addressing the problem of indoor air pollution. The Massachusetts Department of Public Health (DPH) has the only program in the state for partially regulating indoor air pollution in residences. Action is taken on a complaint-oriented basis and only a preliminary analysis is performed for carbon dioxide and carbon monoxide. The Department of Labor and Industries which represents OSHA, is only concerned with indoor air quality in the workplace and has no jurisdiction in residences.

A Memorandum of Understanding between DPH and DEQE specified that they would each regulate indoor air and outdoor air respectively. However, the DPH has recently been referring cases of indoor air pollution problems to DEQE for further investigation because DEQE has more advanced monitoring equipment.⁵⁰ A recent example was a home in Barre, Massachusetts owned by Thelma Tetreault. She was unable to live in her home since last winter because of a very strong chemical odor resulting in chronic headaches and nausea. At the request of DPH, DEQE investigators headed by Don Steele took air samples and used special detectors for tracking the source. Mr. Steele developed a "dry throat" within one half hour. The source detected was a valve which controlled the kerosene feed to the kitchen stove which was used for heating during the winter. The laboratory analysis confirmed that the compounds in the air samples were the same as that from a sample of kerosene.⁵¹

4. OPTIONS FOR ADDRESSING INDOOR AIR POLLUTION BY DEQE

This section addresses the feasibility of DEQE developing a program to monitor and regulate indoor air pollution in Massachusetts. Several recommendations and options are discussed to develop the most comprehensive policy for addressing this vital issue. There are at least five policy options which DEQE can adopt for controlling indoor air pollution:

- 1) No DEQE program
- 2) An Independent DEQE Program

- 3) A comprehensive state program involving all the relevant state agencies - DEQE, DPH, DLI, and Office of Consumer Affairs (OCA).
- 4) Incorporation into "Right-to-Know" Program
- 5) A Joint Program between DEQE and DLI.

4.1) No DEQE Program

There is a growing debate about the level of state (DEQE) intervention in controlling indoor air pollution because, legally, it is considered to be distinct from outdoor air pollution. The primary argument is that the Clean Air Act mandates the state to regulate ambient air pollution. This excludes indoor air pollution. As a result, there is no federal funding from the EPA for the state of Massachusetts (DEQE) to develop a program to regulate indoor air pollution. Whatever program to be developed would have to utilize state funds or a petition would have to be made to EPA for the appropriation of special funds.

The general economic argument for governmental intervention in regulating ambient air pollution is that polluters create external costs in which other people bear the costs. Ambient air is considered to be a public good, but there is considerable debate whether indoor air is the same. However, a strong argument for no DEQE program is that indoor air pollution is considered to create no external costs in that homeowners have the choice of polluting their own space and suffering from the health effects or paying in some way, to reduce the level of pollution. Costs and benefits are therefore considered to be internalized within households and hence the need for DEQE and

other governmental intervention is debatable. Homeowners are free to implement control measures if they perceive that benefits outweigh the costs. This non-DEQE intervention may be appealing for both samplers and residents because they would be relieved of any private intrusions in homes.

The assumption of this non-DEQE intervention argument may be unrealistic because it mistakenly assumes that residents have perfect access to all information about indoor air pollution and that they would use it to make perfectly rational decisions about controlling the problem. In fact, information about indoor air pollution is too scant for decisions to be made solely by residents for controlling indoor air pollution.⁵² Research on indoor air pollution has been rudimentary so far and results from scientific studies are still inconclusive to be useful to residents.

DEQE and other governmental intervention is justifiable in that it is extremely difficult for residents to take action on an individual basis. For example, a house with high formaldehyde levels may cost about \$15,000 for removal of the source plus litigation costs.⁵³ State intervention is necessary for protecting residents from such high cost. Renters need more protection than homeowners because they cannot exert the same degree of control over their homes. State intervention is necessary for establishing guidelines and regulations to protect the general public from indoor air pollution.

4.2) Independent DEQE Program

Massachusetts (DEQE) is nationally respected for its advanced air quality program. However, as far as indoor air quality is concerned, DEQE lags far behind most other state agencies in developing a program for addressing the problem. For example, California's program is the most advanced in the country and their indoor air pollution problem is not as critical as in Massachusetts where the winters are very harsh and the building structures are airtight.

The overall objective of DEQE should be to identify, reduce and prevent disease associated with environmental factors. Since exposure to indoor air pollution presents one of the most substantial environmental health risks,⁵⁴ particularly in the more airtight residences in Massachusetts, DEQE is in a good position for developing and implementing a program for controlling the problem. This program would be a major step in addressing adequately, the total exposure concept to air pollution - both outdoors and indoors. DEQE is well poised to make a substantial contribution in filling a gaping public health need which has not been adequately addressed by the other state institutions.

Because of the increasing number of telephone calls from residents complaining about air pollution indoors, DEQE could set up initially a public information clearinghouse and consulting service. Staff would be needed to record and screen complaints from residents. In responding to a complaint, DEQE's staff could provide the caller with advice and information regarding immediate strategies for reducing the levels of indoor air pollutants. DEQE could provide investigative reports and further recommendations based on sampling results to residents.

DEQE's staff should be able to recognize potential problems from information gathered on the phone while the caller may not be aware of the possible sources. DEQE's staff could take the initiative in delimitting potential sources based on type of health complaints and environmental conditions and recommend remedial approaches. As DEQE's staff gains increasing technical expertise regarding the control of indoor air pollution, fact-sheets could be written to inform the public about specific indoor air pollutants, their related health implications, and the remedial options available for reducing indoor levels. On a preliminary basis, EPA criteria pollutants such as SO₂, NO₂, CO, and TSP could be sampled and monitored indoors and measured at the Tewksbury Laboratory since it is already equipped for testing these pollutants. New monitoring equipment would have to be acquired for the most common indoor air pollutants such as radon, formaldehyde and asbestos.

The first problem for DEQE to address is the monitoring of indoor air quality. Monitoring can be performed on a continuous or non-continuous basis, or both. Since it would be virtually impossible to monitor on a continuous basis for most residences, some selected residences can be monitored. Non-continuous monitoring could be carried out on a complaint-oriented basis. Inexpensive portable personal monitors could be loaned to complainants in cases where the situation is less severe. Complaints can be made to both the regional offices or the Boston Office and monitoring can be done on a grab-sampling basis. Monitors can record on-the-spot for common pollutants and air samples can be taken back to the laboratory for other air pollutants such as formaldehyde, asbestos and radon. The more

critical the indoor air pollution problem, the longer should be the monitoring period. Each laboratory result can be documented and recorded in a master file which can be computer-stored for statistical analysis and future planning programs.

In order to implement an independent DEQE program, DEQE must secure authorization from the state to visit and take samples from private residences. DEQE should be given enforcement powers to sue builders, landlords and manufacturers for contributing to indoor air pollution. This could turn out to be quite complex and costly. However, under the current regulatory conditions, cases could be forwarded to the appropriate enforcement institutions such as DOE, CPSC, and DPH.

The Barre investigation was estimated by Don Steele at a cost of about \$400. However, with the establishment of a systematic monitoring program, this figure should be much lower. Each case may be different and therefore the cost of sampling and analysis may vary.

DEQE is the best equipped state agency for monitoring indoor air pollution because of its advanced ambient air monitoring system. Monitoring indoor air could therefore be an extension of the current ambient monitoring system.

4.3) Comprehensive state program with DEQE and other state agencies

A Massachusetts state indoor air pollution program should be formulated to incorporate the following state agencies: DEQE, DPH, DLI and OCA. Each agency should be responsible for specific aspects of indoor air pollution control. Since DPH has the most experience with dealing with residents' complaints, all complaints could be forwarded to them. They could be responsible

for preliminary sampling and analysis of the basic air pollutants such as CO₂ and CO. If this is inconclusive, then a case could be referred to DEQE for further in-depth analysis. DLI could - continue to be referred to for problems in the workplace since they have no jurisdiction in homes. In the case of sources of indoor air pollutants coming from specific products, this could be referred to the Office of Consumer Affairs for enforcing product standards.

Since there is a higher rate of synergism in the humid indoor environment, standards should be lower for indoor air than the NAAQS. State standards should be set for non-criteria pollutants such as formaldehyde, asbestos and radon.

As it stands now, DEQE has no statutory authority to monitor air quality in homes, whereas DPH is vested with this authority⁵⁵. However, on a preliminary basis, DPH could continue to perform initial sampling and then refer to DEQE for more in-depth investigation and analysis. Any enforcement and litigation should be referred back to DPH. This would require close cooperation between DEQE and DPH.

4.4 Incorporation into Massachusetts Right-to-Know Program

An indoor air pollution program would involve heavy contact with the public and this could be incorporated with the current Massachusetts Right-to-Know Program. This would require a comprehensive public relations department which encompasses indoor air pollution both in the workplace and residences.

4.5 A Joint Program Between DEQE and DLI

Since DLI is one of the most equipped State agencies for monitoring indoor air pollution, particularly in the workplace, this agency could expand its monitoring together with DEQE, in the residential indoor environment. As DLI has no jurisdiction to monitor residential indoor air pollution, DEQE could be given the legal authority. This joint venture would ensure that indoor air pollution would be adequately controlled in both the occupational and residential environments. This joint program would be a major step to adequately addressing the total exposure concept to all air pollution.

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